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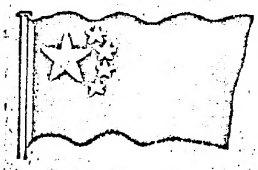
China's new technology



The China giant

7. Natural science

The development of the natural sciences has long been a goal of Communist China's leaders. The reasons are political, military, economic, social, and ideological. But distrust of the scientists — many of them Western trained—has led to uneven scientific development. The Chinese themselves estimate it will take up to 30 years to 'catch up' with the West.

By C. H. G. Oldham
Written for The Christian Science Monitor

Eighteen months ago I traveled by train from Peking to Nanking. It is a 24-hour journey and I shared a four-berth compartment with three Chinese Army officers. Conversation was rather stiff and formal at first. But reserve gradually broke down and the trip proved to be one of the highlights of my month's stay in China. They asked where I was from, and on learning I was British, one of them said, "Oh yes, that is where Watt invented the steam engine. This led to the industrial revolution in England, then America had hers, and now we are having ours."

It was an interesting train of thought. But even as we spoke China proved to the world that its scientific revolution was also well under way. The morning papers in Nanking told me the news. China had successfully exploded its first atomic bomb.

We are so accustomed to think of China in terms of political revolutions that we sometimes forget the other, and perhaps more fundamental, revolutions which are taking place in China: the scientific and technological revolutions. Political systems have a habit of changing, but no society which experienced the scientific revolution has reverted to prescientific ways.

The term scientific revolution is used by historians to refer to the transformation in thought which first took place in Western Europe roughly between A.D. 1500 and 1700. Galileo and Newton lived near the two ends of this time interval.

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After that time in Western Europe, and later in North America, the entire way of thinking of much of society changed. In modern parlance people began to think scientifically. The scientific method began to permeate everyday life. Theory and practice were for the first time consciously combined, and the scene was set for the industrial revolution which came about 100 years later.

But all of this happened only in the West. The rest of the world carried on as before. The consequences are with us today in that greatest of all world problems—the gap between rich nations and poor nations. Civilizations, which before the scientific revolution, were as developed as that of Western Europe—or more so—now find themselves left far behind.

China is one of these civilizations. There are few countries which can claim such an illustrious scientific and technological past as it can. China's problem is that its science was a prescientific revolution variety, where theories were not tested by experiments. It was not modern science.

Inventions listed

True, its early technology was second to none. True also that China made great practical use of these technological inventions. Paper and the seismograph were both invented in the first century, the magnetic compass in the third, and printing with movable type in the eighth. Gunpowder, clockwork, rain gauges, iron smelting—the list of Chinese firsts is long.

Yet, the scientific revolution never came to China. China remained a traditional society.

Attempts to graft modern science onto this traditional society in the late 19th and early 20th centuries met with only little success. However by the late 1930's a definite start had been made.

After the political revolution of 1949, the Communist leaders must have been in something of a dilemma. Science and technology were needed to help attain several of the national policy goals. For example, high on the list of policy objectives was that China become a great world power, respected as an equal by the other great powers. Two ways of demonstrating equality are by developing a powerful military capacity and, since science is a symbol of the modern nation, by scientific excellence.

The Chinese leaders therefore resolved to build nuclear weapons and delivery systems and to catch up with the science in the advanced countries within 12 years.

A second policy goal was to improve the economy of the country. It was realized that science and technology could play a major role in helping to solve the many problems which China faced. In this the leaders were obviously influenced by the Marxist maxim that science should be harnessed for practical gains.

Another goal was to transform China into a Communist society. To do this, the leaders realized the people must reject the traditional, often superstitious, ways of the past. These must be replaced by a more pragmatic approach based on a combination of science and Communist ideology which was to provide

the basis for a new type of society.

Thus for political, military, economic, social, and ideological reasons the Chinese leaders saw the need for science. But the type of science required for the different policy objectives was different. To catch up with the advanced countries meant an emphasis on basic science. The economic and military objectives required an emphasis on applied science. The social or ideological objectives required science education and popularization on a mass scale.

A major problem for the leaders, however, was that, although they obviously appreciated the role that science could play, none of them was a scientist or engineer. There was a great deal they did not understand about the organization of science and the nature of scientific work.

A lack of understanding of science on the part of politicians is not confined to China. But in the Chinese case it was combined with a deep sense of distrust of the scientists, the very people who were needed to implement the science program. This was because many of the scientists who remained in China had been trained in the West. Whenever the scientists gave their expert advice and this conflicted with government policy, the scientists were suspected of opposing the policy for political reasons and were accused of being "rightists."

Goals modified

In retrospect it is perhaps not surprising that the development of science in China over the past 16 years has been uneven. The goals for science are so diverse, the trained manpower so sparse, the technological inexperience of the political cadres so great, and the suspicion and mistrust of Western-trained scientists so much a problem, that despite good financial support some chaos and confusion was probably inevitable.

Nevertheless, it is to the credit of the Chinese leaders that they seem to have been willing to learn from past mistakes, with the result that science in China is at present in an exciting stage of development.

First, the political goal of catching up with the advanced countries is still there. But the brash claims of 10 years ago to catch up in 12 years now have been replaced with more realistic aims for catching up in the next 20 to 30 years. Recent visits by Western scientists to universities and research institutes in China confirm that the emphasis now is placed on laying the foundations for long-range research programs.

The Chinese freely admit that they are handicapped by the lack of project leaders. It is clear that until there has been time to train well-qualified research workers, and for them to mature, it will be impossible for China to make many contributions to fundamental science.

In the meantime, the emphasis is to train new scientists, to build the laboratories and workshops, and to work on relatively few projects. Then to expand when the manpower becomes available.

Nearly all Western scientific visitors report on the excellence of the scientific libraries and the growing amount of advanced scientific instruments now manufactured in China. The adjective most frequently used by these visitors to describe the work and plans which they saw, is "sensible." It seems that the Chinese work is probably on a par with the best in the world in a few branches of the physical sciences. For the most part, however, it is agreed that the Chinese estimate of 20 to 30 years to "catch up" seems realistic.

It is noted that in the last two or three years there seems to have been a new emphasis on the biological sciences. This probably reflects the high priority now given to agriculture.

There seems to be a growing appreciation, too, on the part of the Chinese leaders that for science to thrive there must be international interchange. Scientific exchanges now are taking place between China and many Western countries. Britain and France probably have the greatest interchange. But scientists from Canada, Denmark, Sweden, and Australia have all participated in recent scientific exchanges with China.

Much less is known about military or defense research. Although the Chinese had announced they were working on an atomic bomb, most Western experts were unprepared for the technologically advanced type of bombs which have been detonated.

It is almost certain that China possesses a gaseous diffusion plant to prepare the fissionable material, a type of plant which the French have not yet managed to complete. United States Defense Secretary Robert S. McNamara says that China could soon have a hydrogen bomb. Few would dispute his prediction.

Efforts concentrated

Equally significant is the fact that China gave jet propulsion a high priority in its 12-year plan as long ago as 1956. The work is led by a noted aeronautical engineer, Ch'ien Hsüeh-shen, who received his training at both the Massachusetts and California Institutes of Technology. Further evidence for concentration of effort in this field are the 5,000 college students who graduated in aeronautical engineering between 1953 and 1963, the establishment of the China Aeronautical Engineering Society in 1963, and the theoretical research started in astronomy, geodesy, and celestial mechanics after 1960.

Mr. McNamara's further prediction that China could soon have delivery capabilities for its nuclear weapons also comes as no surprise.

There is little evidence that the military program has siphoned off many scientists or funds from other scientific projects. Obviously large sums of money must have been spent on defense research. Nevertheless the general science program does not seem to have suffered as a consequence.

The third area where science and technology are expected to play an important part is economic development. This primarily means applied research. The bulk of China's scientific effort falls into this category. Many of the scientific academy institutes spend part of their time on applied problems. The branch institutes in the various provinces spend most of their time solving immediate local problems. In addition, various government ministries have their own institutes. As far as one can tell, these concentrate almost exclusively on applied research.

Whether the Chinese have the right balance between basic, applied, and development research is difficult to say. This is partly because we do not have the statistics. And partly because it is difficult to know what is the optimum division of effort in a developing country, such as China. It is reasonable that for short-term economic gains emphasis should be placed on applied research. But long-term growth depends also on basic research.

One interesting feature of Chinese science is the growing emphasis that is placed on the scientist spending part of his time in the field (i.e., in the countryside and factory). This is sometimes criticized in the West as a tremendous waste of talent. In some ways, of course, it is. But developing countries are frequently faced with two problems which do not exist to the same extent in the more advanced countries.

For one thing, it frequently happens that scientists and intellectuals are extremely reluctant to do any type of manual work. It is a prejudice which has to be overcome. The other is the difficulty of ascertaining the key problems in an economically backward country. The best way to find out is for the scientist himself to be brought face to face with the problems. The Chinese system aims to solve both dilemmas.

The fourth use of science is the least understood, and yet in the long run might be most significant. It is to break down old traditional ideas and ways of doing things and to replace them with a combination of science and politics. The transformation has both social and economic returns. Peasants are taught that the laws of nature can not only be understood by man, but that man can use this knowledge for practical gains.

Science is replacing the Dragon King and ghosts. Peasants and factory workers are encouraged to experiment and innovate. Many communes now have experimental plots. Some have their own research institutes. Great praise and sometimes material rewards are showered on peasants and workers who have successfully innovated.

Traditions resisted

Sometimes this has been carried too far, especially